



(12)

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G03G 9/093, 15/16		A1	(11) International Publication Number: WO 92/22018 (43) International Publication Date: 10 December 1992 (10.12.92)
(21) International Application Number:	PCT/JP92/00669		(74) Agent: HOSODA, Yoshinori; Hosoda International Patent Office, 5th Floor Otemae M2 Building, 8-1, Tanimachi 2-chome, Chuo-ku, Osaka-shi, Osaka 540 (JP).
(22) International Filing Date:	25 May 1992 (25.05.92)		
(30) Priority data: 3/155298 30 May 1991 (30.05.91) JP 3/155299 30 May 1991 (30.05.91) JP			(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), LU (European patent), MC (European patent), NL (European patent), SE (European patent), US.
(71) Applicant (for all designated States except US): KAO CORPORATION [JP/JP]; 14-10, Nihonbashi Kayabacho 1-chome, Chuo-ku, Tokyo 103 (JP). (72) Inventors; and (75) Inventors/Applicants (for US only) : YASUDA, Shin-ichiro [JP/JP]; 994, Fuke, Misakicho, Sennan-gun, Osaka 599-03 (JP). KAWABE, Kuniyasu [JP/JP]; 1-55-501, Komatsubara 6-chome, Wakayama-shi, Wakayama 640 (JP).			Published With international search report.

(54) Title: METHOD OF FORMING FIXED IMAGES**(57) Abstract**

A method of forming fixed images comprising charging a photoconductor; exposing the photoconductor to light; developing an electrostatic latent image, whereby a toner is applied to the electrostatic latent image formed on the photoconductor to form a visible image; transferring the formed visible image onto a recording medium such as a recording paper; and fixing the transferred visible image onto the recording medium, wherein said toner is a thermally dissociating encapsulated toner, and the transfer process and the fixing process are simultaneously carried out on the surface of the photoconductor onto the preheated recording medium.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroun	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		

DESCRIPTION

METHOD OF FORMING FIXED IMAGESTECHNICAL FIELD

5 The present invention relates to a method of forming fixed images used for plain paper copying machines, laser printers, plain paper facsimiles, etc. More particularly, it relates to a method of forming images in which transfer and fixing are simultaneously carried out on the surface 10 of the photoconductor using a recording medium whose surface is heated in advance.

BACKGROUND ART

15 Conventionally, when images are formed with copying machines, laser beam printers, etc., the Carlson Method has been generally used (U.S. Patent 2,221,776, 2,297,691 and 2,357,809, "Electrophotography," p22-p41, R.M. Shaffert, 1965, The Focal Press).

20 Figure 2 shows a schematic view of an apparatus used in a conventional method of forming fixed images using an electrophotographic process. In the conventional method, after an electrostatic latent image formed on a photoconductor by optical means is developed in a developing process, it is transferred to a recording medium such as a 25 recording paper in a transfer process and then fixed into the final image generally with heat and pressure in a fixing process. As the photoconductor is repeatedly used, a cleaning device is provided for cleaning the residual toner

after the transfer process with its rotation.

In the conventional method of forming fixed images using an electrophotographic process, however, the processes from the formation of the electrostatic latent image up to its fixing onto the recording medium are time consuming, which makes the apparatus used therein not only complicated but also large. In addition, since the transfer efficiency of the toner is poor in the transfer process, it poses such problems as extra labor needed for the disposal of the toner collected by cleaning the residual toner, and the pollution due to the scattering of the toner in and out of the apparatus.

Therefore, a method of simultaneously conducting transferring and fixing has been proposed (U.S. Patent 4,448,872). In this method, since the transferring and the fixing are simultaneously carried out by pressing the toner image developed on the dielectric drum to the recording medium, the simplification of the apparatus can be surely achieved. However, since only pressure is applied at the fixing, the fixing ability is poor, and a little improvement is achieved in the transfer efficiency.

The fixing of the toner should be generally conducted at a high temperature due to the high melting temperature of the toner, thereby requiring an apparatus with a high thermal efficiency. The fixing process usually works independently, and is carried out at such a high temperature of around 200 °C. Accordingly, expensive heat-resistant materials such as heat-resistant resins, heat-resistant rubbers, etc.

have to be provided in the periphery of the fixing device.

In addition, when the fixing is carried out at a high temperature, it is subject to problems such as curling and jamming of the paper, etc. Therefore, taking into 5 consideration of the radiation from the apparatus, a device highly capable of radiating heat is in demand.

Further, if the fixing requires a high temperature, it takes more time to reach the set temperature so that a quick printing becomes impossible. In such a case, therefore, 10 this method is unsuitable for devices such as a facsimile which requires quick printings.

Further, in view of solving the problems, there has been proposed a method of forming fixed images, wherein the transfer and fixing process is simultaneously carried out by 15 adhering the toner onto a transfer film, which rotates while keeping it partly in close contact with a photoconductor to form a toner image, and putting the recording paper and the transfer film between a pressure roller and a heat roller provided away from the photoconductor (Japanese Patent 20 Laid-Open No. 197884/1990). However, in this method, the processes become more complicated because of the additional step using the transfer film, making the apparatus even larger. In addition, since the exposing is carried out through the transfer film, the exposure lowers, whereby the 25 lines of electric forces corresponding to the electrostatic latent image formed on the photoconductor reduce, and the absorption of the toner decreases, resulting in a poor resolution at the time of developing.

Further, in the conventional method of forming fixed images, however, through the processes from the formation of the electrostatic latent image up to its fixing onto the recording medium, the temperature of the heating element of the fixing device has to remain at a very high level (usually around 200°C) and further a relatively high pressure is required (usually between 2.0 and 6.0 kg/cm). On the other hand, since both the photoconductor and the developing device have to be maintained at around room temperature, a considerable distance has to be maintained between the fixing device and the developing device, which necessitates to make the machine larger. In addition, it is necessary to force the removal of the generated heat from the system, but the noise produced by the forced radiation device is not negligible.

As for solving these problems, a device for carrying out low temperature fixing using a cold pressing method (Japanese Patent Laid-Open No. 159174/1984) is known. In this reference, however, although the fixing temperature is low, the nip pressure has to be elevated normally to not less than 4 kg/cm in this method, making the machine heavier. Moreover, it poses problems in the gloss of the images, deformation of the paper copy sheets and an insufficient fixing strength. As for a fixing device for fixing images at such a low nip pressure of less than 4 kg/cm, a heat roller method is known, for example, but it has been pointed out that the fixing temperature needs to be maintained at not less than 120°C.

Under the circumstances, the development of a fixing device that can fix images at a low temperature and at a low nip pressure is highly desired, but it has not yet been developed. Further, as regards toners to be indispensably used for the image formation, since they have been confined to those made from a thermoplastic resin dispersed with additives such as coloring agents, charge control agents, releasing agents, etc., and pulverized, there have been limitations on the molecular weight, the softening point of the thermoplastic resin for use in the toner from the aspect of storage stability, thereby posing limitations on the further pursuit of low temperature fixing.

From these standpoints, the development of a novel method of forming fixed images as well as a matching toner thereto is in demand.

DISCLOSURE OF INVENTION

An object of the present invention is to provide a novel method of forming fixed images, wherein transferring and fixing are simultaneously carried out on the surface of the photoconductor onto the preheated recording medium, so that the fixing takes place only with a pressure roller, and practically all of the toner is transferred and fixed to the recording medium in the transfer and fixing process, thus providing only a trace amount of the toner lost and a little toner disposed, which makes the toner disposal box and its cleaning process simple and the resulting apparatus extremely compact.

Therefore, in view of solving the above-mentioned problems, the present inventors have investigated a toner shell material which is fragile to heat at a low temperature. As a result, they have found that a thermally dissociating 5 encapsulated toner produced by interfacial polymerization melts at a temperature of not more than 120°C, and they have further investigated the image formation method using this encapsulated toner and have thus developed the present invention.

10 More particularly, in view of solving the above problems, the method of forming fixed images of the present invention comprises charging a photoconductor; exposing the photoconductor to light; developing an electrostatic latent image whereby a toner is applied to the electrostatic latent 15 image formed on the photoconductor to form a visible image; transferring the formed visible image onto a recording medium such as a recording paper; and fixing the transferred visible image onto a recording medium, wherein the toner is a thermally dissociating encapsulated toner, and the 20 transfer process and the fixing process are simultaneously carried out on the surface of the photoconductor onto a preheated recording medium. In addition, the preheating temperature of the recording medium is in the range of not less than 50°C and not more than 160°C.

25 According to the present invention, the visible image formed on the surface of the photoconductor in the developing process is simultaneously transferred and fixed on the surface of the photoconductor to the recording medium whose

surface is heated in advance. Therefore, the transfer and fixing process can be remarkably simplified, and the radiator can be made much smaller due to its low fixing temperature, thereby achieving the miniaturization of an image-forming apparatus. In addition, since an independent transfer process is not required, an adjustment of electric resistance for the recording medium such as a recording paper is not also required.

10 BRIEF DESCRIPTION OF DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, 15 and wherein:

Figure 1 is a schematic view of an apparatus used in the method of forming fixed images as defined by the present invention;

20 Figure 2 is a schematic view of an apparatus used for conventional methods of forming fixed images;

Figure 3 is a schematic view showing the charging process in the method as defined by the present invention;

Figure 4 is a schematic view showing the exposing process in the method as defined by the present invention;

25 Figure 5 is a schematic view showing the developing process in the method as defined by the present invention; and

Figure 6 is a schematic view showing the transfer

and fixing process in the method as defined by the present invention.

The reference numerals in Figures 1 through 6 denote the following elements:

5 Element 1 is a photoconductor, element 1a a photoconductive layer, element 1b a conductive supporter, element 2 an exposure device, element 3 a developer device, element 3a a rotating sleeve, element 4 a heater, element 5a a pressure roller, element 5b is a transfer 10 device, element 6 a recording medium (a recording paper), element 7 a charger, element 8 a cleaner device, element 8a a toner collecting box, element 9 a charge eraser, element 10 a toner, element 12 a fixing roller, element 14 a heat 15 roller.

15

BEST MODE FOR CARRYING OUT THE INVENTION

The toner used in the present invention is a thermally dissociating encapsulated toner. The encapsulated toner according to the present invention comprises a heat-fusible 20 core containing at least a coloring agent and a shell formed thereon so as to cover the surface of the core material. In the present invention, the thermally dissociating encapsulated toner means a toner which comprises a shell 25 whose structure is fragile to heat, and a core material which can be fixed at a low temperature by pressure. More particularly, the shell structure changes with heat, and at the point when pressure is applied, the core material is discharged to effect the fixing of the toner. Depending on

the raw materials and production method, a large variety of encapsulated toners are conceivable, and as long as they are within the range of the required thermal properties, there is no limitations on what production process or 5 materials are used. The toner in the present invention is a thermally dissociating encapsulated toner, and any toner whose fixing temperature is maintained in the range of 40 to 120°C to the recording medium such as a recording paper can be properly chosen.

10 As to the method for producing the encapsulated toners, the following can be mentioned.

(1) Spray-drying method

After the core material is dispersed in a non-aqueous solution of polymer or polymer-emulsion, the dispersed 15 liquid is spray-dried.

(2) Phase separation method (coacervation method)

In a solution of ionic polymer colloids and the core material, phase separation is conducted around the core material. In other words, a simple emulsion is first 20 prepared, which in turn is converted to a complex emulsion, in which the core materials are micro-encapsulated.

(3) Interfacial polymerization method

A core material solution or dispersion is dispersed in a water in oil or oil in water type emulsion system, while 25 at the same time shell material monomers (A) are collected around the surfaces, where in the next method, monomers (A) and monomers (B) react.

(4) Other methods include an in-situ polymerization method,

a submerged cure coating method, an air suspension coating method, an electrostatic coalescing method, a vacuum vapor deposition coating method, etc.

The particularly preferred toner include those produced by the interfacial polymerization method and the spray-drying method. While the spray-drying method has the merits of an easy function separation for the core material and shell material and a large choice of shell materials, the interfacial polymerization method not only has the merit of an easy function separation for the core material and shell material but also is capable of producing a uniform toner in an aqueous state. Moreover, substances of low softening points can be used for the core material in the interfacial polymerization method, making it particularly suitable from the aspect of fixing ability. Accordingly, in the present invention, the thermally dissociating encapsulated toner produced by the interfacial polymerization method among others is particularly preferred.

For shell materials, styrene resins (Japanese Patent
20 Laid-Open No.205162/1983), polyamide resins (Japanese Patent
Laid-Open No.66948/1983), epoxy resins (Japanese Patent
Laid-Open No.148066/1984), polyurethane resins (Japanese
Patent Laid-Open No.179860/1982), polyurea resins (Japanese
Patent Laid-Open No.150262/1987) and many others have been
25 proposed. And as substances fixible under heat and pressure
contained in the core material, thermoplastic resins having
glass transition points (Tg) of between 10°C and 50°C such
as polyester resins, polyamide resins, polyester-polyamide

resins, and vinyl resins can be used.

As compared to the thermal properties of the core material, the structure and the thermal properties of the shell material concern themselves remarkably with the fixing ability of the entire toner. Since a particular polyurethane resin among the above-mentioned resins for the shell materials is thermally dissociating, having excellent storage stability and fixing ability at a low temperature, it is an extremely favorable material for the method of forming fixed images of the present invention. As principal components of such a shell material, resins obtainable from the reaction between an isocyanate compound and/or isothiocyanate compound and compounds containing a phenolic hydroxy group and/or a thiol group are preferably used (EP0453857A).

The thermally dissociating encapsulated toner suitably used in the present invention can be produced by any known methods such as interfacial polymerization, etc., and this encapsulated toner is composed of a heat-fusible core material containing at least a coloring agent and a shell formed thereon so as to cover the surface of the core material, wherein the main components of the shell are a resin prepared by reacting:

(A) an isocyanate and/or isothiocyanate compound comprising:

- (1) 0 to 30 mol % of a monovalent isocyanate and/or isothiocyanate compounds, and
- (2) 100 to 70 mol % of at least a divalent

isocyanate and/or isothiocyanate compounds
with

(B) an active hydrogen compound comprising:

5 (3) 0 to 30 mol % of a compound having one
active hydrogen atom reactive with
isocyanate and/or isothiocyanate groups and
(4) 100 to 70 mol % of a compound having at least
two active hydrogen atoms reactive with the
isocyanate and/or isothiocyanate groups

10 at a molar ratio of the component (A) to the component (B)
of between 1:1 and 1:20, and wherein at least 30% of all of
the linkages formed from the isocyanate or isothiocyanate
groups are thermally dissociating linkages.

15 According to the present invention, the thermally
dissociating linkage is preferably one formed by the
reaction between a phenolic hydroxyl and/or thiol group and
an isocyanate and/or isothiocyanate group.

20 Examples of the monovalent isocyanate compounds to be
used as the the component (1) in the present invention
include ethyl isocyanate, octyl isocyanate, 2-chloroethyl
isocyanate, chlorosulfonyl isocyanate, cyclohexyl
isocyanate, n-dodecyl isocyanate, butyl isocyanate, n-hexyl
isocyanate, lauryl isocyanate, phenyl isocyanate,
m-chlorophenyl isocyanate, 4-chlorophenyl isocyanate,
25 p-cyanophenyl isocyanate, 3,4-dichlorophenyl isocyanate,
o-tolyl isocyanate, m-tolyl isocyanate, p-tolyl
isocyanate, p-toluenesulfonyl isocyanate, 1-naphthyl
isocyanate, o-nitrophenyl isocyanate, m-nitrophenyl

isocyanate, p-nitrophenyl isocyanate, p-bromophenyl isocyanate, o-methoxyphenyl isocyanate, m-methoxyphenyl isocyanate, p-methoxyphenyl isocyanate, ethyl isocyanatoacetate, butyl isocyanatoacetate and 5 trichloroacetyl isocyanate.

Examples of the divalent or higher isocyanate compounds to be used as the component (2) in the present invention include aromatic isocyanate compounds such as 2,4-tolylene diisocyanate, 2,4-tolylene diisocyanate dimer, 2,6-tolylene diisocyanate, p-xylylene diisocyanate, m-xylylene diisocyanate, 4,4'-diphenylmethane diisocyanate, 1,5-naphthylene diisocyanate, 3,3'-dimethyldiphenyl-4,4'-diisocyanate, 3,3'-dimethyldiphenylmethane-4,4'-diisocyanate, m-phenylene diisocyanate, triphenylmethane triisocyanate and 15 polymethylenephene isocyanate; aliphatic isocyanate compounds such as hexamethylene diisocyanate, trimethylhexamethylene diisocyanate, lysine diisocyanate and dimer acid diisocyanates; alicyclic isocyanate compounds such as isophorone diisocyanate, 4,4'-methylenebis-20 (cyclohexyl isocyanate), methylcyclohexane-2,4 (or 2,6)-diisocyanate and 1,3-(isocyanatomethyl)cyclohexane; and other isocyanate compounds such as an adduct of 1 mol of trimethylolpropane with 3 mol of tolylene diisocyanate.

Examples of the isothiocyanate compounds include phenyl isothiocyanate, xylylene-1,4-diisothiocyanate and ethylidene diisothiocyanate.

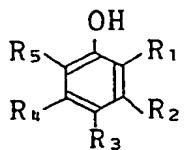
Among these isocyanate and isothiocyanate compounds, compounds having an isocyanate group directly bonded to an

aromatic ring are preferred, because they are effective in forming a urethane resin having a low thermal dissociation temperature.

According to the present invention, the monovalent isocyanate and/or isothiocyanate compound (1) also serves as a molecular weight modifier for the shell-forming resin and can be used in an amount of at most 30 mol % based on the isocyanate component and/or the isothiocyanate component. When the amount exceeds 30 mol %, the storage stability of the obtained encapsulated toner is undesirably poor.

Examples of compounds having one active hydrogen atom reactive with isocyanate and/or isothiocyanate groups to be used as component (3) in the present invention include aliphatic alcohols such as methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, butyl alcohol, isobutyl alcohol, tert-butyl alcohol, pentyl alcohol, hexyl alcohol, cyclohexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, lauryl alcohol and stearyl alcohol; aromatic alcohols such as phenol, o-cresol, m-cresol, p-cresol, 4-butylphenol, 2-sec-butylphenol, 2-tert-butylphenol, 3-tert-butylphenol, 4-tert-butylphenol, nonylphenol, isononylphenol, 2-propenylphenol, 3-propenylphenol, 4-propenylphenol, 2-methoxyphenol, 3-methoxyphenol, 4-methoxyphenol, 3-acetylphenol, 3-carbomethoxyphenol, 2-chlorophenol, 3-chlorophenol, 4-chlorophenol, 2-bromophenol, 3-bromophenol, 4-bromophenol, benzyl alcohol, 1-naphthol, 2-naphthol and 2-acetyl-1-naphthol; and amides such as ϵ -caprolactam.

Particularly, a phenol derivative represented by the following formula (I) is preferably used:



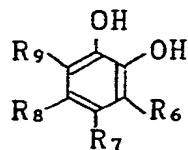
(I)

wherein R₁, R₂, R₃, R₄ and R₅ each independently represents a hydrogen atom, an alkyl group having 1 to 9 carbon atoms, an alkenyl, alkoxy, alkanoyl, carboalkoxy or aryl group or a halogen atom.

10 Examples of the dihydric or higher alcohols among the compounds having at least two active hydrogen atoms reactive with isocyanate and/or isothiocyanate groups to be used as the component (4) in the present invention include catechol, 15 resorcinol, hydroquinone, 4-methylcatechol, 4-tert-butylcatechol, 4-acetylcatechol, 3-methoxycatechol, 4-phenylcatechol, 4-methylresorcinol, 4-ethylresorcinol, 4-tert-butylresorcinol, 4-hexylresorcinol, 20 4-chlororesorcinol, 4-benzylresorcinol, 4-acetylresorcinol, 4-carbomethoxyresorcinol, 2-methylresorcinol, 5-methylresorcinol, tert-butylhydroquinone, 2,5-di-tert-butylhydroquinone, 2,5-di-tert-amylhydroquinone, 25 tetramethylhydroquinone, tetrachlorohydroquinone, methylcarboaminohydroquinone, methylureidohydroquinone, benzonorbornene-3,6-diol, bisphenol A, bisphenol S, 3,3'-dichlorobisphenol S, 2,2'-dihydroxybenzophenone, 2,4-dihydroxybenzophenone, 4,4'-dihydroxybenzophenone, 2,2'-dihydroxydiphenyl, 4,4'-dihydroxydiphenyl,

2,2'-dihydroxydiphenylmethane, 3,4-bis(p-hydroxyphenyl)hexane, 1,4-bis(2-(p-hydroxyphenyl)propyl)benzene, bis(4-hydroxyphenyl)methylamine, 1,3-dihydroxynaphthalene, 1,4-dihydroxynaphthalene, 1,5-dihydroxynaphthalene, 2,6-dihydroxynaphthalene, 1,5-dihydroxyanthraquinone,
 5 2-hydroxybenzyl alcohol, 4-hydroxybenzyl alcohol, 2-hydroxy-3,5-di-tert-butylbenzyl alcohol, 4-hydroxy-3,5-di-tert-butylbenzyl alcohol, 4-hydroxyphenethyl alcohol, 2-hydroxyethyl 4-hydroxybenzoate, 2-hydroxyethyl 4-hydroxyphenylacetate, resorcinol mono-2-hydroxyethyl ether,
 10 hydroxyhydroquinone, gallic acid and ethyl 3,4,5-trihydroxybenzoate.

Among these dihydric or higher alcohols, catechol derivatives represented by the following formula (II) and
 15 resorcinol derivatives represented by the following formula (III) are preferably used:

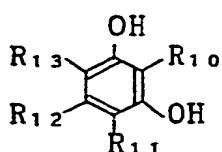


(II)

20

wherein R₆, R₇, R₈ and R₉ each independently represents a hydrogen atom, an alkyl group having 1 to 6 carbon atoms, an alkenyl, alkoxy, alkanoyl, carboalkoxy or aryl group or a halogen atom.

25



(III)

wherein R₁₀, R₁₁, R₁₂ and R₁₃ each independently represents a hydrogen atom, an alkyl group having 1 to 6 carbon atoms, an alkenyl, alkoxy, alkanoyl, carboalkoxy or aryl group or a halogen atom.

Further, examples of the compounds having at least one isocyanate- or isothiocyanate-reactive functional group other than the hydroxyl group and at least one phenolic hydroxyl group include o-hydroxybenzoic acid, m-hydroxybenzoic acid, p-hydroxybenzoic acid, 5-bromo-2-hydroxybenzoic acid, 3-chloro-4-hydroxybenzoic acid, 4-chloro-2-hydroxybenzoic acid, 5-chloro-2-hydroxybenzoic acid, 3,5-dichloro-4-hydroxybenzoic acid, 3-methyl-2-hydroxybenzoic acid, 5-methoxy-2-hydroxybenzoic acid, 3,5-di-tert-butyl-4-hydroxybenzoic acid, 4-amino-2-hydroxybenzoic acid, 5-amino-2-hydroxybenzoic acid, 2,5-dinitrosalicylic acid, sulfosalicylic acid, 4-hydroxy-3-methoxyphenylacetic acid, catechol-4-carboxylic acid, 2,4-dihydroxybenzoic acid, 2,5-dihydroxybenzoic acid, 2,6-dihydroxybenzoic acid, 3,4-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid, 3,4-dihydroxyphenylacetic acid, m-hydroxycinnamic acid, p-hydroxycinnamic acid, 2-amino-4-methylphenol, 2-amino-5-methylphenol, 5-amino-2-methylphenol, 3-amino-2-naphthol, 8-amino-2-naphthol, 1-amino-2-naphthol-4-sulfonic acid, 2-amino-5-naphthol-4-sulfonic acid, 2-amino-4-nitrophenol, 4-amino-2-nitrophenol, 4-amino-2,6-dichlorophenol, o-aminophenol, m-aminophenol, p-aminophenol, 4-chloro-2-aminophenol, 1-amino-4-hydroxyanthraquinone, 5-chloro-2-hydroxyaniline, α -cyano-3-

hydroxycinnamic acid, α -cyano-4-hydroxycinnamic acid, 1-hydroxynaphthoic acid, 2-hydroxynaphthoic acid, 3-hydroxynaphthoic acid and 4-hydroxyphthalic acid.

Further, examples of the polythiol compounds having at least one thiol group in each molecule include ethanethiol, 1-propanethiol, 2-propanethiol, thiophenol, bis(2-mercaptopethyl) ether, 1,2-ethanedithiol, 1,4-butanedithiol, bis(2-mercaptopethyl) sulfide, ethylene glycol bis(2-mercaptopacetate), ethylene glycol bis(3-mercaptopropionate), 2,2-dimethylpropanediol bis(2-mercaptopacetate), 2,2-dimethylpropanediol bis(3-mercaptopropionate), trimethylolpropane tris(2-mercaptopacetate), trimethylolpropane tris(3-mercaptopropionate), trimethylolethane tris(2-mercaptopacetate), trimethylolethane tris(3-mercaptopropionate), pentaerythritol tetrakis(2-mercaptopacetate), pentaerythritol tetrakis(3-mercaptopropionate), dipentaerythritol hexakis(2-mercaptopacetate), dipentaerythritol hexakis(3-mercaptopropionate), 1,2-dimercaptobenzene, 4-methyl-1,2-dimercaptobenzene, 3,6-dichloro-1,2-dimercaptobenzene, 3,4,5,6-tetrachloro-1,2-dimercaptobenzene, xylylenedithiol and 1,3,5-tris(3-mercaptopropyl) isocyanurate.

In the thermally dissociating shell-forming resin used in the present invention, at least 30%, preferably at least 50% of all of the linkages formed from isocyanate or isothiocyanate groups are thermally dissociating linkages. When the content of the thermally dissociating linkages is

less than 30%, the strength of the shell in the heat-and-pressure fixing cannot be sufficiently lowered, making it less likely to exhibit any advantageous fixing performance of the core material.

5 In the thermally dissociating encapsulated toner of the present invention, other compounds having an isocyanate-reactive functional group other than phenolic hydroxyl and thiol groups, which may be used as a shell-forming material in such an amount as not to lower the ratio of the linkages formed by the reaction of isocyanate and/or isothiocyanate groups with phenolic hydroxyl and/or thiol groups to the all of the linkages formed from isocyanate and/or isothiocyanate groups is less than 30%, include, for example, the following active methylene compounds such as 10 malonate and acetoacetate, oxime such as methyl ethyl ketone 15 oxime, carboxylic acid, polyol, polyamine, aminocarboxylic acid and aminoalcohol.

According to the present invention, the compound having one active hydrogen atom reactive with isocyanate and/or isothiocyanate groups as the component (3) may be used in an 20 amount of at most 30 mol % based on the active hydrogen component. When the amount exceeds 30 mol %, the storage stability of the resulting toner is undesirably poor.

Further, the molar ratio of (A) the isocyanate compound 25 and/or isothiocyanate compound comprising the components (1) and (2) to (B) the active hydrogen compounds comprising the components (3) and (4) preferably lies between 1:1 and 1:20 in order to obtain a resin free from unreacted isocyanate

groups.

In the production of the encapsulated toner according to the present invention, the shell is preferably formed by an interfacial polymerization or an in-situ polymerization.

5 Alternatively, it may be formed by a dry method comprising stirring in an air stream at a high rate matrix particles used as a core material together with particles used as a shell-forming material having a number-average particle size of one-eighth or less of that of the matrix particles.

10 The resins to be used as core materials of the encapsulated toner according to the present invention are thermoplastic resins having glass transition points (Tg) of 10 to 50°C, and examples thereof include polyester resins, polyester-polyamide resins, polyamide resins and vinyl resins, among which vinyl resins are particularly preferable. When 15 the glass transition point (Tg) is less than 10°C, the storage stability of the resulting encapsulated toner is undesirably poor, and when it exceeds 50°C, the fixing strength of the encapsulated toner is undesirably poor.

20 Examples of the monomers constituting the vinyl resins include styrene and its derivatives such as styrene, o-methylstyrene, m-methylstyrene, p-methylstyrene, α -methylstyrene, p-ethylstyrene, 2,4-dimethylstyrene, p-chlorostyrene and vinylnaphthalene; ethylenically 25 unsaturated monoolefins such as ethylene, propylene, butylene and isobutylene; vinyl esters such as vinyl chloride, vinyl bromide, vinyl fluoride, vinyl acetate, vinyl propionate, vinyl formate and vinyl caproate;

ethylenic monocarboxylic acids and esters thereof such as acrylic acid, methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropyl acrylate, n-butyl acrylate, isobutyl acrylate, tert-butyl acrylate, amyl acrylate, cyclohexyl acrylate, n-octyl acrylate, iso-octyl acrylate, decyl acrylate, lauryl acrylate, 2-ethylhexyl acrylate, stearyl acrylate, methoxyethyl acrylate, 2-hydroxyethyl acrylate, glycidyl acrylate, 2-chloroethyl acrylate, phenyl acrylate, methyl α -chloroacrylate, methacrylic acid, methyl 10 methacrylate, ethyl methacrylate, n-propyl methacrylate, isopropyl methacrylate, n-butyl methacrylate, isobutyl methacrylate, tert-butyl methacrylate, amyl methacrylate, cyclohexyl methacrylate, n-octyl methacrylate, iso-octyl methacrylate, decyl methacrylate, lauryl methacrylate, 15 2-ethylhexyl methacrylate, stearyl methacrylate, methoxyethyl methacrylate, 2-hydroxyethyl methacrylate, glycidyl methacrylate, phenyl methacrylate, dimethylaminoethyl methacrylate and diethylaminoethyl methacrylate; ethylenic monocarboxylic acid derivatives such 20 as acrylonitrile, methacrylonitrile and acrylamide; ethylenic dicarboxylic acids and derivatives thereof such as dimethyl maleate; vinyl ketones such as vinyl methyl ketone; vinyl ethers such as vinyl methyl ether; vinylidene halides such as vinylidene chloride; and N-vinyl compounds such as 25 N-vinylpyrrole and N-vinylpyrrolidone.

Among the above core material resin-constituting monomers according to the present invention, the core material-forming resin contains, in the main skeleton of the

resin, styrene or its derivatives preferably in an amount of 50 to 90 parts by weight, and the ethylenic monocarboxylic acid or an ester thereof preferably in an amount of 10 to 50 parts by weight to control the thermal properties of the 5 resin, such as the softening point.

When the monomer composition constituting the core material-forming resin according to the present invention contains a crosslinking agent, which may be also used, if necessary, as a mixture of two or more of them, any known 10 crosslinking agents may be properly used. When the amount of the crosslinking agent added is too large, the resulting toner is less likely to be heat-fused, thereby resulting in poor heat fixing ability and heat-and-pressure fixing ability. On the contrary, when the amount is too small, in 15 heat-and-pressure fixing, a part of the toner cannot be completely fixed on a paper but rather adheres to the surface of a roller, which in turn is transferred to a subsequent paper which creates the so-called "offset" or "offset phenomenon". Accordingly, the amount of the 20 crosslinking agent is preferably 0.001 to 15% by weight, more preferably 0.1 to 10% by weight, based on the monomers used.

The core material of the thermally dissociating encapsulated toner according to the present invention may 25 further contain, if necessary, one or more offset inhibitor of any known kind for the purpose of improving offset resistance at heat-and-pressure fixing. These offset inhibitors are contained in an amount of 1 to 20% by weight

based on the resin contained in the core material.

The core material of the thermally dissociating encapsulated toner according to the present invention contains a coloring agent, which may be any one of the dyes 5 and pigments used in the conventional toners. The coloring agent is generally contained in an amount of 1 to 15 parts by weight per 100 parts by weight of the resin contained in the core material.

In addition, in the shell-forming materials of the 10 thermally dissociating encapsulated toner according to the present invention and in the core material, a metal-containing dye which has been used for toners, for example, a metal complex of an organic compound having a carboxyl or nitrogenous group, such as nigrosine, may be added in an 15 effective amount as a charge control agent. Alternatively, such a charge control agent may be mixed with the toner.

The thermally dissociating encapsulated toner according to the present invention may contain, if necessary, a fluidity improver and/or a cleanability improver. Further, 20 for the purpose of controlling the developability of the encapsulated toner, an additive, for example, finely powdered polymethyl methacrylate, etc. may be added. Furthermore, for the purposes of toning or resistance control, a small amount of carbon black may be used.

25 The thermally dissociating encapsulated toner of the present invention preferably has a softening point of 80 to 150°C. If the softening point is lower than 80°C, the offset resistance of the resulting encapsulated toner is undesirably

poor, and when it exceeds 150°C, the fixing strength of the encapsulated toner is undesirably poor.

Although the particle size of the encapsulated toner according to the present invention is not particularly limited, the average particle size thereof is generally 5 3 to 30 μ m. The preferred thickness of the shell of the encapsulated toner is from 0.01 to 1 μ m. When the thickness is less than 0.01 μ m, the blocking resistance of the resulting encapsulated toner is poor, and when it exceeds 10 1 μ m, the heat fusibility of the resulting encapsulated toner is undesirably poor.

Examples of the thermally dissociating encapsulated toners which is preferably used in the present invention will be described below, but the present invention is not 15 restricted to these alone.

The method of forming fixed images of the present invention are detailed below, referring to the drawings.

Figure 1 is a schematic view of an apparatus used in the method of forming fixed images as defined by the present 20 invention. Element 1 is a photoconductor such as of amorphous silicon or organic photoconductor, etc. in which a photoconductive layer is provided on a conductive supporter. For photoconductors, those practically used are photoconductors of selenium, silicon, organic groups, etc., 25 and any of these can be used. However, as described below, since the photoconductor is exposed to a considerable amount of heat from the recording medium heated in advance, the silicon photoconductors and the organic photoconductors

having good heat resistance are preferred. In addition, since the transferring and fixing are carried out on the surface of the photoconductor, the photoconductors having good security and wear resistance, and further a good releasing ability with the toner are preferably used.

5 Element 7 is a charger located opposite to the photoconductor 1. The charging means is not particularly restricted, and any of, for instance, a corona charger, a brush charger, a roller charger, etc. can be used. Element 10 2 is an exposure device located opposite to the photoconductor 1 for forming electrostatic latent images on the photoconductor surface. For an ~~exposure device~~ 2, light sources such as laser beams, LED or EL arrays, etc. are used in combination with an image-forming optical system.

15 Alternatively, a device based on optical systems projecting a reflected light of a document generally provided in the copying machine can be used. Element 3 is a developer device located opposite to the photoconductor 1 for making visible the electrostatic latent image formed on the 20 photoconductor with the toner. For a developer device, any of the commonly used two-component magnetic brush developer device, the one-component magnetic brush developer device, the one-component non-magnetic developer device, etc. can be used.

25 Element 4 is a heater, and element 5a is a pressure roller, and the heater 4 is disposed just before the point where the photoconductor 1 contacts the pressure roller 5a, so that the preheated recording medium can be conveyed to the

pressure roller. In addition, although the distance between the photoconductor and the heater is preferably kept as little as possible for the purpose of preventing the decrease in the surface temperature of the paper, the heater 4 is preferably set at a proper distance from the photoconductor so as not to cause thermal effects or thermal deformation on the photoconductor. The heater is normally arranged at a distance of about 1.0 to 10.0 cm away from the point where the photoconductor contacts the pressure roller. In addition, in order to increase preheating efficiency, the heater is preferably arranged nearly in parallel with the upper portion of the conveying route for the recording paper. The heater 4 is a device for preheating the surface of the recording medium such as a recording paper, wherein the surface comes in contact with the toner. As long as it is a device capable of heating the surface of the recording medium up to 160°C, any type of heat source can be used for the heater 4. Heating bodies of the heater 4 include, for example, a hot plate, a quartz heater, a flash heater, a heating belt, a heating element, etc., with preference given to the quartz heater and the heating element. The pressure roller 5a is a means for pressure-welding the preheated recording medium onto the surface of the photoconductor. In an ordinary fixing device, it is necessary to use heat-resistant silicone rubbers, etc. in order to carry out fixing at a high temperature. However, in the present invention, it is not required to use the pressure roller having a particularly high heat resistance,

since the pressure roller in contact with the reverse side of the preheated recording medium is not directly heated, and the temperature transmitted to the pressure roller is remarkably low. Therefore, as long as the materials for the 5 pressure roller are elastic bodies having a good heat resistance at not less than 150°C, there are no limitations on its materials, and any of the ordinary inexpensive elastic materials including, for instance, heat-resistant polyurethane resins, acrylic resins, nitrile resins and non-10 conjugated diene terpolymer resins such as EPDM can be used. In addition, since the nip pressure of the pressure roller is usually 0.1 to 4.0 kg/cm², preferably 0.2 to 2 kg/cm², the durability thereof becomes longer. Incidentally, in the present invention, a belt may be used as a similar means 15 in the place of the pressure roller.

After the transfer and fixing process, the cleaner device 8 such as a cleaning web for removing trace amounts of the toner remaining on the surface of the photoconductor is arranged opposite to the photoconductor 1.

20 The photoconductor 1 and the pressure roller 5a rotate at a constant peripheral speed in the direction shown in Figure 1 by a specified driving means not illustrated in the figure. In addition, a recording paper 6 used as a recording medium is conveyed in the manner shown in Figure 25 1. The recording paper 6 is then pressed between the pressure roller 5a and the photoconductor 1 to transfer and fix the visible image, and discharged out of the system by a paper discharging means not illustrated in the figure. In

this connection, the conveying speed of the recording medium and the heating temperature of the heater is so regulated that the preheating temperature for the recording medium is maintained within the predetermined temperature 5 ranges.

Since the toner used in the method of the present invention is not subject to charging in the transfer process, not only insulating encapsulated toners but also conductive encapsulated toners can be used. Depending on 10 the raw materials and production methods, a large variety of encapsulated toners are conceivable, and as long as they are within the range of the required thermal properties, there are no limitations on what production process or materials are used. Specifically, those having thermal properties 15 capable of melting the toner on the recording medium heated in advance at a temperature range of between 50°C and 160°C and of fixing the toner by pressure of a pressure roller can be properly chosen. In general, the fixing temperature of the toner to the recording medium is in the range of between 20 40°C and 120°C.

Next, the individual processes of the method of forming fixed images by the present invention having the above-mentioned construction will be described.

Figure 3 shows a charging process, Figure 4 an exposing 25 process, Figure 5 a developing process and Figure 6 a transfer and fixing process.

In the charging process, as shown in Figure 3, a specified charge is uniformly supplied, e.g. by the corona

charger 7 to the photoconductor surface. A photoconductor sensitive to a positive charge is taken here for an example, and the surface of the conductive supporter 1b is coated with the photoconductive layer 1a to form the 5 photoconductor 1. A high voltage is applied by the corona charger 7 to the photoconductive layer 1a, thereby positively charging the surface of the photoconductive layer 1a.

In the exposing process, as shown in Figure 4, a light 10 from the exposure device 2 is irradiated to the surface of the related photoconductor, so that a leakage of charges occurs only in the exposed parts to form an electrostatic latent image on the photoconductive layer 1a.

In the developing process, as shown in Figure 5, the 15 toner triboelectrically charged inside the developer device is transported by the rotating sleeve 3a, and developed onto the photoconductor surface in proportion to the charge on the photoconductor surface. The developing process is an assortment of normal development in which a reversely 20 polarized toner adheres to the charges by the Coulomb's force and of reverse development in which the toner adheres to the charges lost due to exposure to the light. The development process in the present invention applies to either method, but the case of the normal development is 25 illustrated in Figure 5.

In the transfer and fixing process, as shown in Figure 6, the visible image formed by applying the toner to adhere to a latent image on the surface of the photoconductor is

conveyed. At the same time, a recording medium 6 such as a recording paper preheated by a heater 4 is pressure-welded onto the surface of the photoconductor by pressing the reverse side of the recording medium by a pressure roller 5a so as to synchronize with the initial end of the visible image, and thereby the visible image is simultaneously transferred and fixed onto the recording medium 6. In other words, when the toner adhered to the latent image formed on the surface of the photoconductor is pressure-welded to the recording medium, the deformation of the shell structure of the encapsulated toner due to the heat held in the recording medium takes place at the same time with the discharging of the core material in the encapsulated toner due to pressure of the pressure roller. When the temperature applied to the surface of the recording medium by the heater ~~is too high~~, the recording paper tends to curl, and when ~~it is too low~~, sufficient fixing of the toner cannot be achieved, making record preservation difficult. Therefore, the surface of the recording medium is usually heated to a temperature of between 50°C and 160°C, preferably between 50°C and 120°C.

In the present invention, since substantially all of the toner is transferred to the recording medium, a toner collecting device is not required. Incidentally, although trace amounts of the toner may remain on the surface of the photoconductor 1 after the transferring of the toner to the recording medium 6, this toner can be removed by pressure-welding the photoconductor with such devices as a cleaning

web arranged opposite to the photoconductor, making it possible to repeatedly use the photoconductor.

Further, when the transfer and fixing process is completed, the charges remaining on the photoconductor are 5 neutralized by a ~~charge eraser~~ such as a charge erasing lamp arranged opposite to the photoconductor 1, so that the photoconductor 1 is reused for the charging process.

In addition, the present invention is not confined to the above-mentioned embodiments, and specifications of the 10 kinds of individual apparatus, processes etc. can be revised based on the principles of the present invention.

By using the method of forming fixed images of the present invention, the following effects can be obtained:

(1) Since the fixing is carried out at a low temperature by 15 using a toner having good fixing ability and by only preheating the recording medium, the fixing takes place by only using a pressure roller, thereby making the apparatus extremely compact.

(2) Since the heating temperature is low and the heat from 20 the surface of the recording medium does not directly contact the pressure roller, a high heat resistance is not required for the pressure roller. Accordingly, inexpensive elastic members can be used as the materials of the pressure roller, and the duration of the roller becomes long.

(3) Since substantially all of the toner is transferred to 25 the recording medium in the transfer and fixing process, little loss of the toner takes place, thereby causing substantially no toner to be discharged from the apparatus.

Accordingly, the toner collecting box and the cleaning process can be simplified, thus making it possible to achieve low cost and miniaturization in the overall apparatus.

5 (4) Since the toner for the low-temperature fixing is used, the temperature of the heating body in the fixing device can be set low with only a small rise in the temperature in the system, thereby making it possible to miniaturize the forced radiation device.

10 (5) Since the surface of the recording medium is heated in a preheating process, a cardboard paper is also applicable for the method of the present invention.

(6) Since the fixing takes place without going through an electrostatic process, the conductive toners can also be used, and an electrostatic inducing-type development capable 15 of applying low voltage can also be used.

The present invention is hereinafter described in more detail by means of the following working examples, but the present invention is not limited by them.

20 Production Example of Encapsulated Toner:

To a mixture comprising 70.0 parts by weight of styrene, 30.0 parts by weight of 2-ethylhexyl acrylate and 1.0 part by weight of divinylbenzene, 10.0 parts by weight of carbon black "# 44" (manufactured by Mitsubishi Chemical Industries, Ltd.), 4.0 parts by weight of 2,2'-azobisisobutyronitrile, 9.5 parts by weight of 4,4'-diphenylmethane diisocyanate "Millionate MT" (manufactured by Nippon Polyurethane Industry Co., Ltd.) are added. The

obtained mixture is introduced into an attritor (manufactured by Mitsui Miike Kakoki) and dispersed at 10°C for 5 hours to give a polymerizable composition. This composition is added to 800 g of a 4% by weight aqueous 5 colloidal solution of tricalcium phosphate which has been preliminarily prepared in a 2-liter separable glass flask, so as to give a concentration of 30% by weight. The obtained mixture is emulsified and dispersed with a TK homomixer (manufactured by Tokushu Kika Kogyo) at 5°C and a 10 rotational speed of 10000 rpm for 2 minutes. A four-necked glass cap is set on the flask, and a reflux condenser, a thermometer, a dropping funnel fitted with a nitrogen inlet tube and a stainless steel stirring rod are set thereon. The resulting flask is placed on an electric mantle heater. 15 A solution of 22.0 g of resorcinol, 3.6 g of diethyl malonate and 0.5 g of 1,4-diazabicyclo [2.2.2] octane in 40 g of ion-exchanged water is prepared, and the resulting mixture is dropped into the flask in a period of 30 minutes through the dropping funnel while stirring. Thereafter, the 20 contents are heated to 80°C and reacted for 10 hours in a nitrogen atmosphere while stirring. After cooling the reaction mixture, it is dissolved into 10%-aqueous hydrochloric acid. The resulting mixture is filtered and the obtained solid is washed with water, dried under a 25 reduced pressure of 20 mmHg at 45°C for 12 hours and classified with an air classifier to give the encapsulated toner with an average particle size of 9 μ m having a shell made of a resin having a thermally dissociating urethane

linkage. The glass transition point assignable to the resin contained in the core material is 30.2°C, and its softening point is 130.0°C.

Production Example of Reference Toner:

5 To 100 parts by weight of a polyester resin (Bisphenol-type polyester resin; softening point: 135°C; Tg: 65°C), 7 parts by weight of carbon black (manufactured by Mitsubishi Kasei Ltd., MA8), 3 parts by weight of a polypropylene wax (Sanyo Kasei Ltd., Biscol 660P), and 2 parts by weight of a 10 charge control agent (Orient Kagaku Kabushiki Kaisha, Bontron N-01) are mixed, and the resulting mixture is kneaded by a pressurized kneader. After cooling the obtained mixture, it is pulverized with a pulverizing mill and then classified with a classifier to obtain a 15 toner having a particle distribution range of 5 to 25 μm and an average particle size of 10 μm . To 1 kg of the toner, 5 g of colloidal silica (Nihon Aerozil Ltd.: R972) is externally added to obtain a surface-treated reference toner.

20 Test Example 1:

50 g of the toner obtained in Production Example of Encapsulated Toner is blended together with 1 kg of a commercially available coated ferrite carrier by using a V-type blender to obtain a developer 1. The obtained 25 developer 1 is used to carry out copying by using a modified apparatus of a commercially available copying machine as schematically shown in Figure 1. Specifically, a heat-resistant, organic photoconductor is used as a

photoconductor, and a quartz heater is used as a heater and arranged at a distance of 3.0 cm away from the point where the photoconductor contacts the pressure roller.

5 In addition, by varying the heating temperature and the conveying velocity, the temperature on the surface of the recording paper is properly adjusted so as to preheat the paper surface to a temperature of between 60°C and 160°C. The pressure roller used in the transfer and fixing is made of silicone rubber having a roller diameter of 30 10 mmφ, and transfer and fixing are carried out at a nip pressure of 0.5 kg/cm and a peripheral speed of 160 mm/sec.

As a result, the lowest fixing temperature of the paper surface is 100°C, and substantially no melting of the toner 15 to the surface of the photoconductor is observed at a temperature of between 80°C and 140°C.

On the other hand, the toner obtained by the Production Example of Reference Toner is blended with a commercially available coated ferrite carrier to prepare a developer 2. 20 Copying is carried out in the same manner as above using the modified apparatus. As a result, the lowest fixing temperature of the paper surface is 140°C.

The lowest fixing temperature for the toner is the temperature of the paper surface at which the fixing rate of 25 the toner exceeds 70%. This fixing rate of the toner is determined by placing a load of 500 g on a sand-containing rubber eraser having a bottom area of 15 mm x 7.5 mm which contacts the fixed toner image, placing the loaded eraser on

a fixed toner image obtained in the fixing device, moving the loaded eraser on the image backward and forward five times, measuring the optical reflective density of the eraser-treated image with a reflective densitometer 5 manufactured by Macbeth Co., and then calculating the fixing rate from this density value and a density value before the eraser treatment using the following equation.

$$\text{Fixing rate} = \frac{\text{Image density after eraser treatment}}{\text{Image density before eraser treatment}} \times 100$$

10

Test Example 2:

The developer 1 obtained in Test Example 1 is used to carry out copying by using a modified apparatus of a commercially available copying machine as schematically 15 shown in Figure 1. Specifically, a heat-resistant, organic photoconductor is used as a photoconductor, and a quartz heater is used as a heater and arranged at a distance of 3.0 cm away from the point where the photoconductor contacts the pressure roller. In addition, by varying the heating 20 temperature and the conveying velocity, the temperature on the paper surface of the recording paper is properly adjusted so as to preheat the paper surface to a temperature of between 90°C and 140°C. The pressure roller used in the transfer and fixing is made of silicone rubber having a 25 roller diameter of 30 mmφ, and the developer 1 obtained in Test Example 1 is used to carry out a continuous copying test for 1000 sheets by adjusting to a nip pressure of 0.5 kg/cm and a peripheral speed of 60 mm/sec. As a result,

under the conditions in which the temperature of the paper surface of the recording paper at preheating is 100°C, the fixing is good, and substantially no curling, jamming, etc. of the paper are observed.

5 On the other hand, the developer 2 obtained in Test Example 1 is used to carry out continuous copying for 1000 sheets in the same manner as above. As a result, when the temperature on the paper surface is not more than 120°C, continuous copying cannot be carried out because of cold offsetting from the initial copying, and when it is not 10 less than 120°C, jamming of the sheets frequently takes place.

15 From these test examples, it is confirmed that by utilizing the method of forming fixed images according to the present invention using a thermally dissociating encapsulated toner, the lowest fixing temperature can be remarkably lowered, thereby resulting in no curling or jamming of the paper sheets feeded to the copying machine.

20 The present invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

CLAIMS

1. A method of forming fixed images comprising
charging a photoconductor;
5 exposing said photoconductor to light;
developing an electrostatic latent image, whereby
a toner is applied to said electrostatic latent image
formed on said photoconductor to form a visible image;
transferring the formed visible image onto a
10 recording medium such as a recording paper; and
fixing the transferred visible image onto the
recording medium,
wherein said toner is a thermally dissociating encapsulated
toner, and the transfer process and the fixing process are
15 simultaneously carried out on the surface of said
photoconductor onto the preheated recording medium.

2. The method according to claim 1, wherein said
recording medium is preheated to a temperature of not
20 less than 50°C and not more than 160°C.

3. The method according to claim 1, wherein said
toner is a thermally dissociating encapsulated toner which
comprises a heat-fusible core material containing at least a
25 coloring agent and a shell formed thereon so as to cover the
surface of the core material, wherein the main component of
the shell is a resin prepared by reacting:

(A) an isocyanate and/or isothiocyanate compound

comprising:

- (1) 0 to 30 mol % of monovalent isocyanate and/or isothiocyanate compounds, and
- (2) 100 to 70 mol % of at least divalent isocyanate and/or isothiocyanate compounds with

5 (B) an active hydrogen compound comprising:

- (3) 0 to 30 mol % of a compound having one active hydrogen atom reactive with the isocyanate and/or isothiocyanate groups and
- (4) 100 to 70 mol % of a compound having at least two active hydrogen atoms reactive with the isocyanate and/or isothiocyanate groups

10 15

at a molar ratio of the component (A) to the component (B) of between 1:1 and 1:20, and wherein at least 30% of all of the linkages formed from the isocyanate or isothiocyanate groups are thermally dissociating linkages.

20

4. The method according to claim 3, wherein said thermally dissociating linkage is a linkage derived from reacting phenolic hydroxyl and/or thiol groups with the isocyanate and/or isothiocyanate groups.

25

5. The method according to claim 3, wherein said heat-fusible core material comprises a thermoplastic resin as its main component, whose glass transition point is 10°C

— 40 —

to 50°C.

6. The method according to claim 3, wherein the
softening point of said thermally dissociating encapsulated
toner is 80°C to 150°C.

10

15

20

25

1 / 4

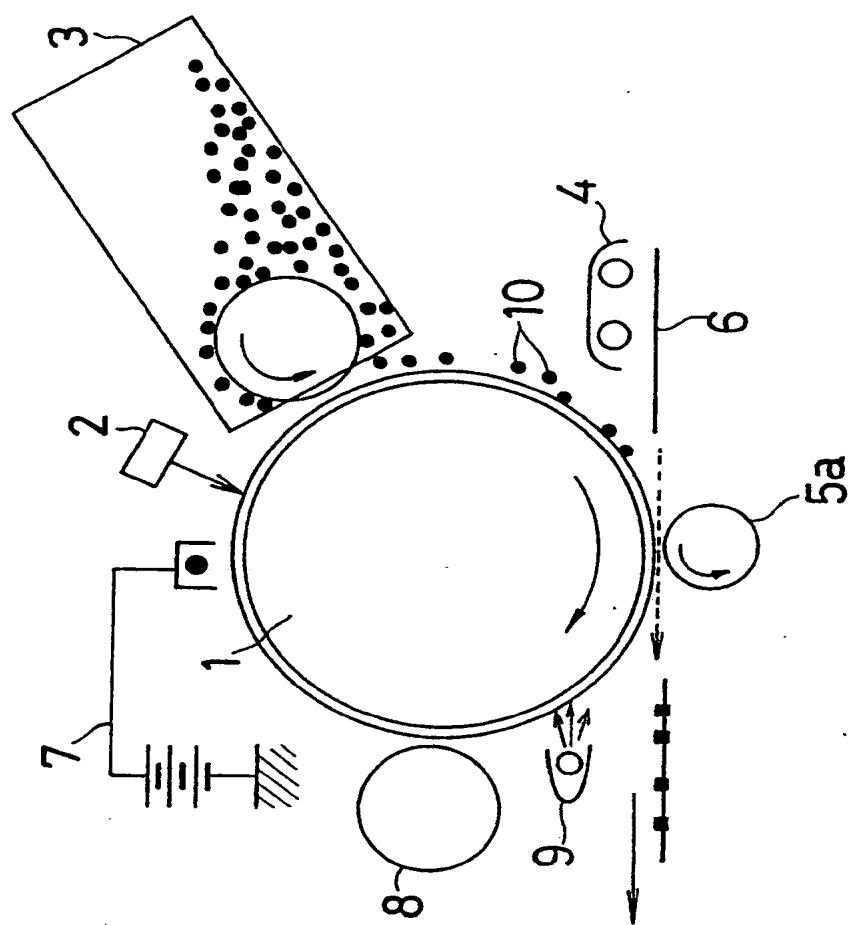


FIG. 1

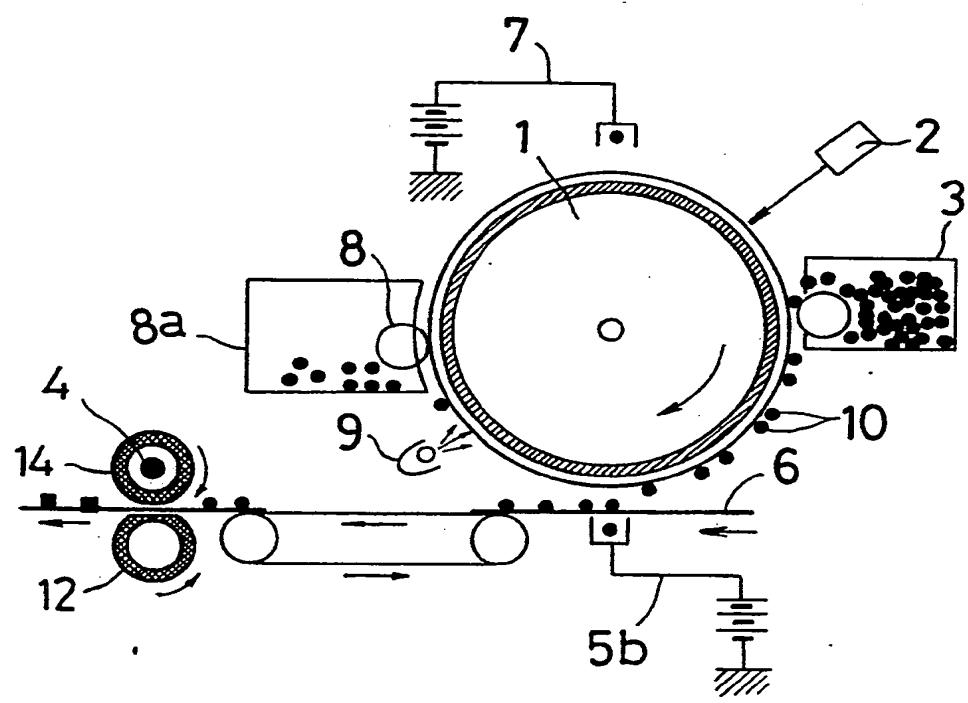


FIG. 2

3 / 4

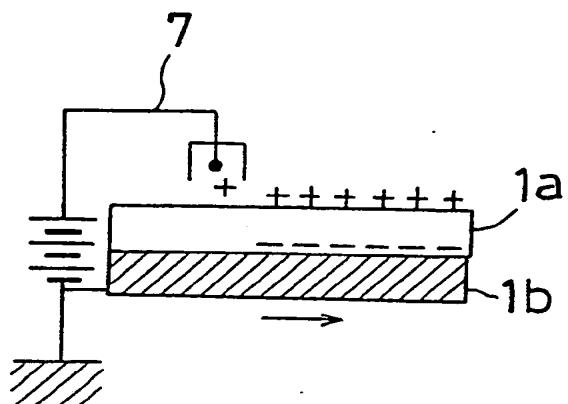


FIG. 3

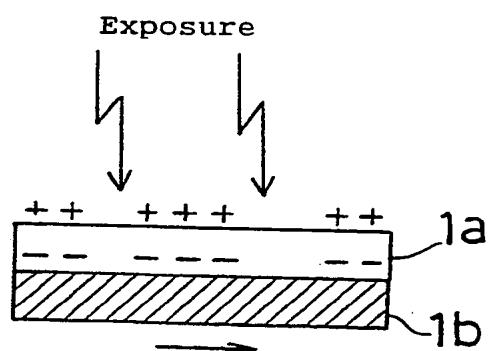


FIG. 4

4 / 4

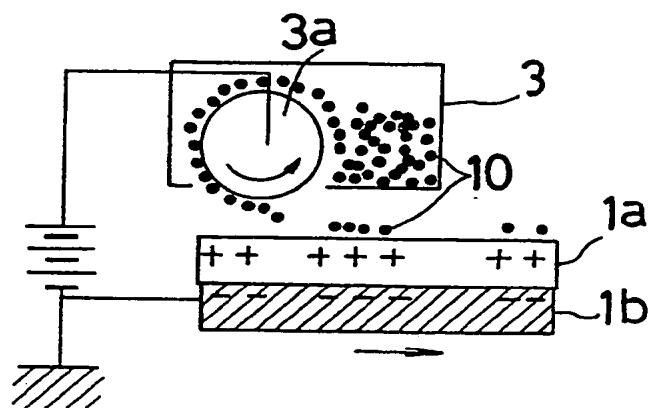


FIG. 5

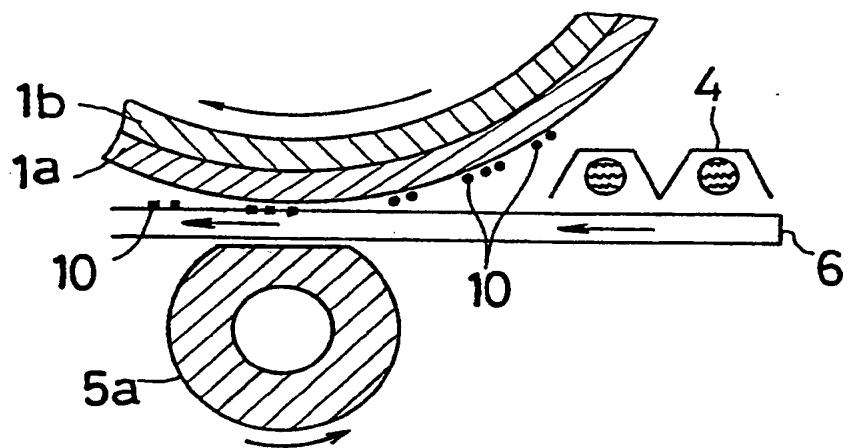


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 92/00669

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.C1. 5 G03G9/093; G03G15/16

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
Int.C1. 5	G03G

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	DE,A,3 133 021 (KONISHIROKU) 15 April 1982 see page 12, paragraph 2 - page 13, paragraph 1; figure 1 ---	1-2
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 86 (P-349)(1809) 16 April 1985 & JP,A,59 214 862 (TOSHIBA) 4 December 1984 see abstract ---	1-2
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 6 (P-247)(1443) 12 January 1984 & JP,A,58 168 071 (CANON) 4 October 1983 see abstract ---	1-2
A	PATENT ABSTRACTS OF JAPAN vol. 7, no. 10 (P-168)(1155) 14 January 1983 & JP,A,57 168 267 (RICOH) 16 October 1982 see abstract ---	1-2
		-/-

¹⁰ Special categories of cited documents :

- ¹¹ "A" document defining the general state of the art which is not considered to be of particular relevance
- ¹² "E" earlier document but published on or after the international filing date
- ¹³ "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- ¹⁴ "O" document referring to an oral disclosure, use, exhibition or other means
- ¹⁵ "P" document published prior to the international filing date but later than the priority date claimed

- ¹⁶ "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- ¹⁷ "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- ¹⁸ "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- ¹⁹ "Z" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search
19 AUGUST 1992

Date of Mailing of this International Search Report

04.09.92

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

VOGT, CAROLA

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB,A,2 107 892 (FUJI PHOTO) 5 May 1983 see page 3, line 109 - page 4, line 65; claims 1-5 ---	3-6
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 422 (P-1104)(4365) 12 September 1990 & JP,A,2 163 749 (CANON) 25 June 1990 see abstract ---	1-6

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. JP
SA

9200669
59536

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 19/08/92

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A-3133021	15-04-82	JP-B-	1000698	09-01-89
		JP-C-	1516884	07-09-89
		JP-A-	57041673	08-03-82
		US-A-	4755849	05-07-88
GB-A-2107892	05-05-83	JP-A-	58066949	21-04-83
		US-A-	4803144	07-02-89

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant:

Defects in the images include but are not limited to the items checked:

BLACK BORDERS

IMAGE CUT OFF AT TOP, BOTTOM OR SIDES

FADED TEXT OR DRAWING

BLURRED OR ILLEGIBLE TEXT OR DRAWING

SKEWED/SLANTED IMAGES

COLOR OR BLACK AND WHITE PHOTOGRAPHS

GRAY SCALE DOCUMENTS

LINES OR MARKS ON ORIGINAL DOCUMENT

REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY

OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.